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CAA'S ANALYSIS OF THE ARMY WATERCRAFT RESTRUCTURING PLAN (CA4WRP)

FEBRUARY 2002

CENTER FOR ARMY ANALYSIS
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13. ABSTRACT *(Maximum 200 Words)*
In 2001, the Combined Arms Support Command (CASCOM) completed the Army Watercraft Restructuring Plan (AWRP), recommending changes to the watercraft fleet's force structure. The Army G4, Force Projection and Distribution Directorate, requested that the Center for Army Analysis (CAA) analyze the negative aspects of the proposed changes in terms of personnel and training. CAA's Analysis of the AWRP (CA4WRP) analyzed Unit Status Report (USR) data and utilized a discrete event simulation to model past and future activities in the fleet at various force structure levels. CA4WRP modeled demand deterministically (for planned operations) and stochastically (for unplanned operations, from historical data). The simulation attempts to meet demand with the given force structure. Output from the simulation includes tempo rates for units and training days lost to demand exceeding supply.

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CAA'S ANALYSIS OF THE ARMY WATERCRAFT RESTRUCTURING PLAN (CA4WRP)

SUMMARY

THE PROJECT PURPOSE was to provide analytical insight into what impact various restructuring plans will have on the watercraft fleet.

THE PROJECT SPONSOR was the Deputy Chief of Staff, G4, Force Projection and Distribution Directorate (DALO-FPD), BG Parker. MG Dail, the Chief of Transportation (COT), and his staff also gave guidance during the development of the study.

THE PROJECT OBJECTIVES were to:

   (1)   Determine the impact of various plans on Active Component (AC) deployment tempo (DEPTEMPO), measured as the percentage of time that a unit is away from home.

   (2) Determine the Reserve Component (RC) support requirements generated by the various plans to allow the AC to adhere to the 33 percent maximum DEPTEMPO policy issued by the Army G3 for requirements determination.

   (3) Determine the impact of various plans on training (with emphasis on 8th Brigade).

THE SCOPE OF THE PROJECT. CA4WRP I analyzed the impact of the Unit Status Report (USR) data to determine historical DEPTEMPO levels for logistic support vessels (LSV), landing craft utility (LCU) vessels, and 128-foot large tugs (LT). Forecasts were then made for future DEPTEMPO levels under Army Watercraft Restructuring Plan (AWRP). CA4WRP II, based upon guidance from the COT, utilized a discrete event simulation to analyze the impact of AWRP on LSVs and LCUs in terms of DEPTEMPO and training opportunities.

THE PRINCIPAL FINDINGS are that**:**

   (1) AWRP will favorably impact the watercraft fleet's DEPTEMPO levels. Under AWRP, no units in the fleet will, on average, experience DEPTEMPO levels above the Army G3's maximum of 33 percent.

   (2) AWRP will adversely impact the training conducted by the 8th Brigade (US Army Transportation School). Under AWRP, the 8th Brigade will lose an average of 71 days of LCU support and 28 days of LSV support from 7th Group per year.

THE PROJECT EFFORT was conducted by MAJ Robert Shearer, Force Strategy Division, Center for Army Analysis (CAA).

COMMENTS AND QUESTIONS may be sent to the Director, Center for Army Analysis, ATTN: CSCA-FS, 6001 Goethals Road, Suite 102, Fort Belvoir, VA 22060-5230.

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CONTENTS   **Page**

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1 METHODOLOGY

1.1 Background

In 1999, the Chief of Transportation (COT), MG Mortensen, requested a Doctrine, Training, Leadership, Organization, Material, and Soldiers (DTLOMS) analysis of the Army watercraft program with the following guidance: (1) position Army watercraft for strategic and operational response, (2) ensure the quantity and type watercraft to support commander in chief (CINC) requirements, (3) balance the force structure without degrading capability, and (4) modernize and sustain the fleet while focusing on future investments. The Combined Arms Support Command (CASCOM) conducted the study, the Army Watercraft Restructuring Plan (AWRP), and published final results in November 2001. The AWRP recommended relocation of several units and an increase in the number of multi-component units in the fleet, paid for by a decrease in AC units. In October 2001, BG Parker, the Director, the Army G4, Force Projection and Distribution Directorate (DALO-FPD), requested that CAA initiate CA4WRP I to determine the impact of implementing the AWRP on logistic support vessels (LSV), landing craft utility (LCU) vessels, and 128-foot large tug (LT) boats, in terms of deployment tempo (DEPTEMPO). MG Dail, the current COT, requested CA4WRP II in November 2001, narrowing the focus to the impact of the AWRP on LSVs and LCUs in terms of DEPTEMPO and training opportunities lost, with particular emphasis on 8th Brigade training supported by the 7th Transportation Group.

1.2 Timeline

MAJ Robert Shearer, Force Strategy Division, CAA, began work on CA4WRP I in October 2001 and completed the work in November 2001. CA4WRP II began in November 2001 and ended in February 2002.

1.3 Purpose and Objectives

The purpose of the projects was to provide analytical insight into what impact various restructuring plans will have on the watercraft fleet. CA4WRP I had two objectives:

1. Determine the impact of various plans on Active Component (AC) DEPTEMPO (measured as the percentage of time that a unit is away from home station) for LSV, LCU, and LT vessels.

2. Identify other personnel issues for future analysis.

Based upon the findings from CA4WRP I and additional guidance from the COT, CA4WRP II had three objectives:

1. Determine the impact of various plans on AC DEPTEMPO for LSVs and LCUs.

2. Determine the RC support requirements generated by the various plans to allow the AC to adhere to the 33 percent maximum DEPTEMPO policy issued by the Army G3 for requirements determination.

3. Determine the impact of various plans on training.

1.4 Approach

CA4WRP I. Unit Status Report (USR) data were analyzed to measure historical DEPTEMPO levels across the fleet and to predict future levels under AWRP. USR separates DEPTEMPO into four categories: Category A – On-post Training, Category B – Offpost Training, Category C - Joint Exercises, and Category D – Smaller-scale Contingencies (SSC). Historical means and standard deviations were calculated and histograms generated from 1999-2001 USR reports for LSV detachments, heavy boat companies (HBC) (the unit type with LCUs), and floating craft (FC) companies (the unit type with 128-foot tugs). Predictions for each vessel type under AWRP were then calculated assuming that unplanned demand (Categories C and D) would remain constant and that planned demand (Categories A and B) was proportional to the number of vessels in the fleet. Ninety-five percent confidence intervals were then created for the predicted mean for each vessel type.

CA4WRP II. A discrete event simulation was developed to capture the impact of the AWRP in terms of DEPTEMPO and training days lost. The concept behind the simulation was to schedule the Army's demand for watercraft out over a 3-year period, creating demand for watercraft force structure, and then allocate Army forces to fill this demand. Statistics would then be calculated to determine DEPTEMPO and training opportunities lost by unit. Two types of demand for watercraft exist--planned and unplanned. Planned demand consists of all operations known in advance, to include: mission essential task list (METL) training, joint exercises, scheduled Forces Command (FORSCOM) missions, 8th Brigade support missions, and cyclic maintenance. Unplanned demand consists of all operations that are not known in advance, to include SSCs and unscheduled FORSCOM missions. Planned demand was modeled deterministically, following schedules obtained from units. Unplanned demand was modeled stochastically, utilizing historical data to fit distributions for interarrival times between unplanned operations, the duration of the operations, and the number of vessels required by type. Supply is a function of the vessels, by location, number, and crew type, available under the given restructuring plan. Unplanned demand preempts planned demand, generating training days lost to real-world missions. The simulation ran for 3 years to allow all vessels to rotate through one complete maintenance cycle.

1.5 Assumptions

CA4WRP I.

1. All of the demand that units experience is captured in the four USR DEPTEMPO categories:

    a. Category A – On-post Training

    b. Category B – Offpost Training

    c. Category C - Joint Exercises

    d. Category D - SSCs

2. Category A and B events are internal, generated by units to maintain proficiency. Category C and D events are external, generated by sources outside the control of the unit.

CA4WRP II.

1. **Fleetwide**

   a. Future demand for vessels will follow historical trends.

   b. All units are capable of performing all assigned missions without augmentation from other units.

   c. METL missions vary proportionally to the number of crews.

   d. Demand for unplanned missions occurs regardless of the number of vessels available.

   e. Reserve crews are available for 30 consecutive days of deployment per year without a callup.

   f. Cyclic maintenance requires 90 days every 3 years.

   g. Active Guard Reserve (AGR) crews are equivalent to AC crews in terms of deployability.

   h. FORSCOM will equitably spread CONUS LCU unplanned demand across the 481st, 824th, and 97th Heavy Boat Companies (HBC).

      i. The 481st will fly crews to the East Coast to handle their share of the demand.

      ii. The East Coast HBCs (824th, 97th) will provide vessels for the 481st to utilize.

   i. FORSCOM will equitably spread CONUS LSV unplanned demand across LSV 3 (Tacoma), 4 (Eustis), 8 (Baltimore), and 9 (Baltimore).

      i. LSV 3 will fly its crew to the East Coast to handle their share of the demand.

      ii. East Coast LSV detachments (LSVs 4, 8, 9) will provide vessels for the LSV 3 crew to utilize.

2. **East Coast**

   a. 8th Brigade mission demand is constant, regardless of the number of vessels stationed at Fort Eustis.

   b. Only 7th Group will provide watercraft support to the 8th Brigade.

3. **West Coast**

   a. METL demand is equivalent to historical 7th Group levels.

   b. No forecasted unplanned demand on the West Coast.

1.6   Input Data

CA4WRP I. The Army G3, Operations, Readiness, and Mobilization Directorate (DAMO-OD), provided USR data for all LSV detachments, HBCs, and FCs for the years 1999-2001.

CA4WRP II. The Army G3, Force Development Directorate (DAMO-FM), provided the Army watercraft force structure for the years 1999-2001 and the proposed force structure under AWRP. *(See Figure 1 below. The watercraft fleet was broken out into the following regions for analysis {West Coast, 7ᵗʰ Group, East Coast (-), European Command (EUCOM), Central Command (CENTCOM), and Pacific Command (PACOM)}, the box on the top portrays how data is displayed under each region; the first line under each region lists the vessels and crews in the region from 1999-2001, the second line lists the vessels and crews scheduled for the region under AWRP; the two boxes on the bottom break out the units assigned to each region under the two time periods.)*
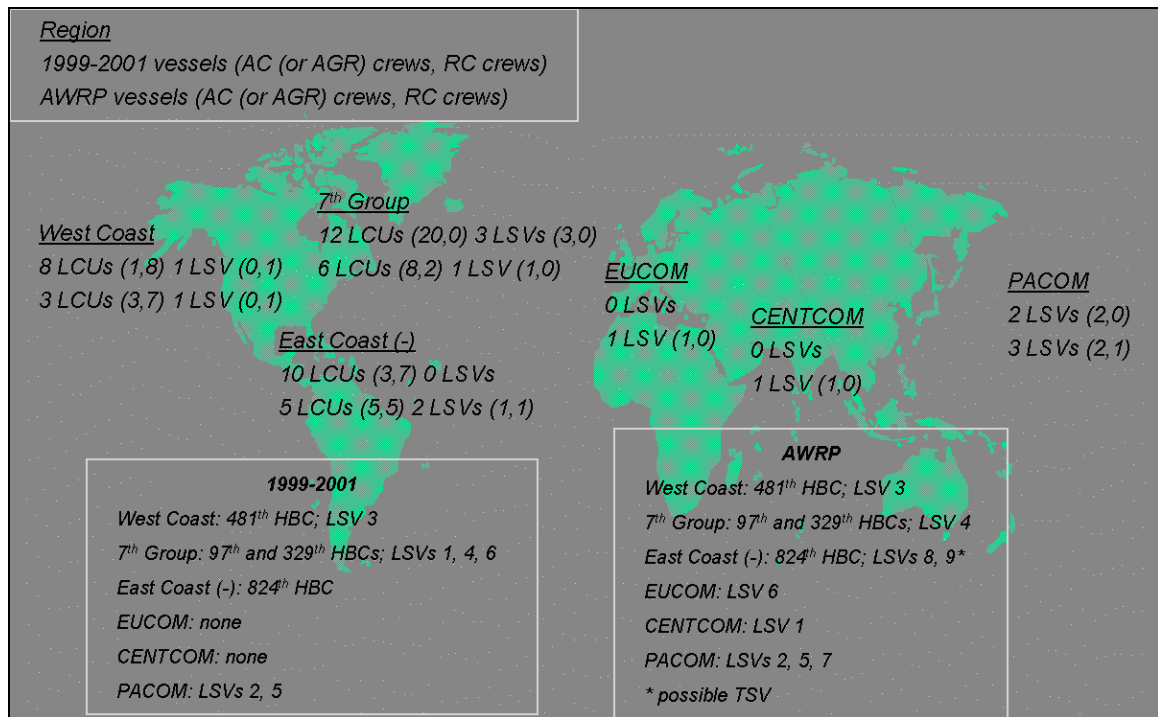

Figure 1. Army Watercraft Force Structure

The Office of the Chief of Transportation (OCOT) and the 7ᵗʰ Transportation Group provided operational information for the unplanned operations that occurred during the years 1999-2001. This information included the start and end date of each operation, the number of vessels, by type, committed to the operation, and the unit that provided the vessels. 7ᵗʰ Transportation Group also provided their METL training schedules for 2000-2001. 8ᵗʰ Brigade provided its program of instruction (POI) for 2001 and the corresponding support request sent to 7ᵗʰ Group. This request listed each specific support request by date, duration, vessel type, and number of vessels.

2 ANALYSIS

2.1 CA4WRP I

AC watercraft units reported the following historical DEPTEMPO levels for 1999-2001: on average LSVs 38.13 percent, LCUs 39.62 percent, and LTs 14.43 percent. Both LSV and LCU units exceeded the G3's DEPTEMPO maximum policy of 33 percent. (*See Figure 2 below; the white dot in each box represents the median, the boxes cover the inter-quartile ranges, the brackets identify the minimum and maximum historical observations.*)
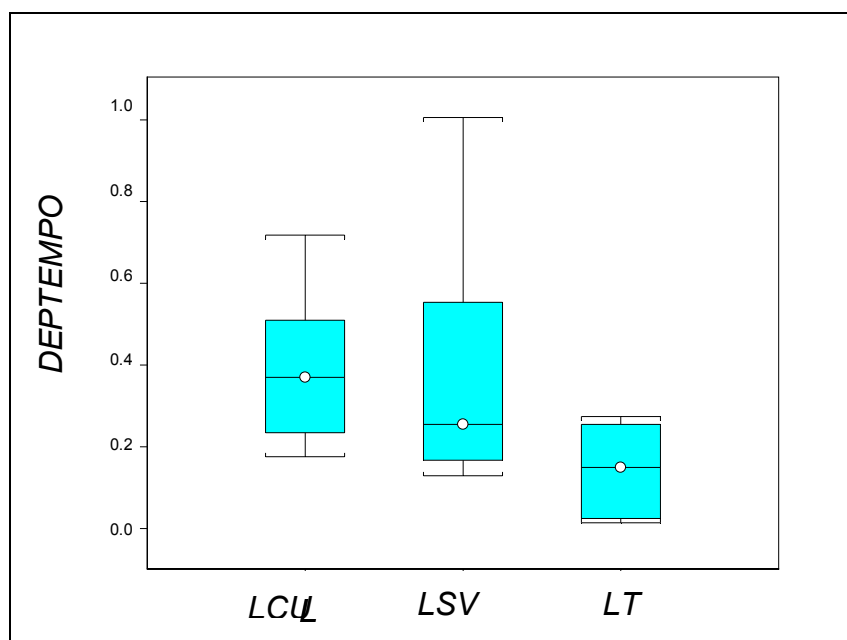
Figure 2. USR Historical DEPTEMPO Levels (1999-2001)

Forecasted LSV DEPTEMPO under AWRP averaged 37.94 percent, with a 95 percent confidence interval for the mean containing (22.81, 52.99). Forecasted LCU DEPTEMPO under AWRP averaged 48.07 percent, with a 95 percent confidence interval for the mean containing (24.47, 71.67). Forecasted LT DEPTEMPO under AWRP averaged 9.61 percent, with a 95 percent confidence interval for the mean containing (4.47, 14.75).

Several shortcomings with this analysis became apparent during the conduct of the study. First, the USR data was found to vary widely in accuracy from unit to unit (one unit reported DEPTEMPO in excess of 100 percent). Given the small number of watercraft units analyzed, just one unit under- or over-reporting its DEPTEMPO could significantly skew the results. Second, the approach fails to take into account the nonlinear impacts of the conflict between training and operations that occurs daily in units. The approach implicitly assumes that the proportion of training cancelled due to real-world missions is independent of the fleet size, when the relationship is clearly dependent.

These shortcomings, combined with the COT's desire for more detail, led to the decision to model the watercraft fleet with a discrete event simulation in CA4WRP II.

2.2 CA4WRP II

CA4WRP II analysis compares two possible scenarios under AWRP: (1) 7th Group receiving proportional support in SSCs from the other CONUS units and (2) 7th Group receives no support. The first case is referred to as "with support" or "support;" the second case is referred to as "without support" or "no support."

7th Transportation Group

LSV DEPTEMPO. 7th Group's simulated LSV DEPTEMPO averaged 36 percent from 1999-2001. Simulated 1999-2001 DEPTEMP levels were utilized instead of the historical level to provide a common reference point for analyzing the impact of changes in the fleet. The deployment of LSV 1 in support of the Kosovo Force (KFOR) contributed significantly to the high DEPTEMPO. Under AWRP, average DEPTEMPO will decrease to either 22 percent (with support) or 31 percent (without support). The reason for the forecasted decrease in DEPTEMPO rests largely upon the fact that the unplanned demand 7th Group experienced in supporting KFOR shifts to EUCOM under AWRP. (*See Figure 3 below; the yellow dotted line indicates 1999-2001 average DEPTEMPO, the blue dotted line indicates forecasted average DEPTEMPO with support, the blue bars indicate the distribution of DEPTEMPO of the 100 runs with support, the purple dotted line indicates forecasted average DEPTEMPO without support, the purple bars indicate the distribution of DEPTEMPO of the 100 runs without support, and the dotted green line represents the Army G3 DEPTEMPO maximum.*)
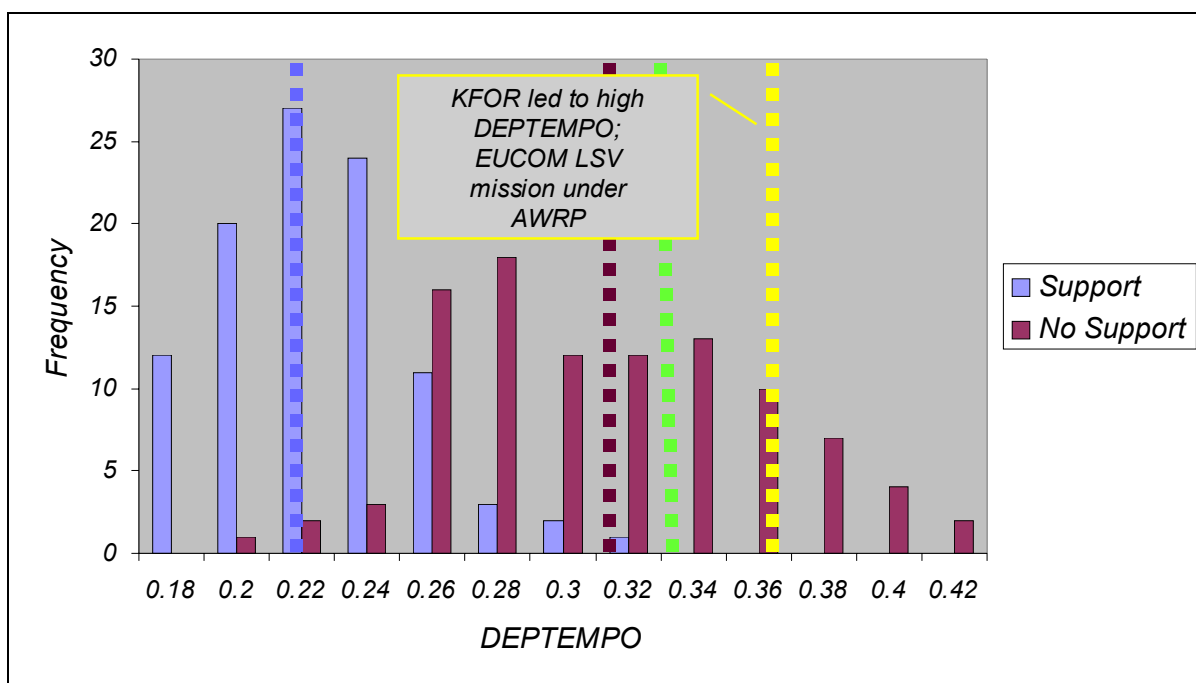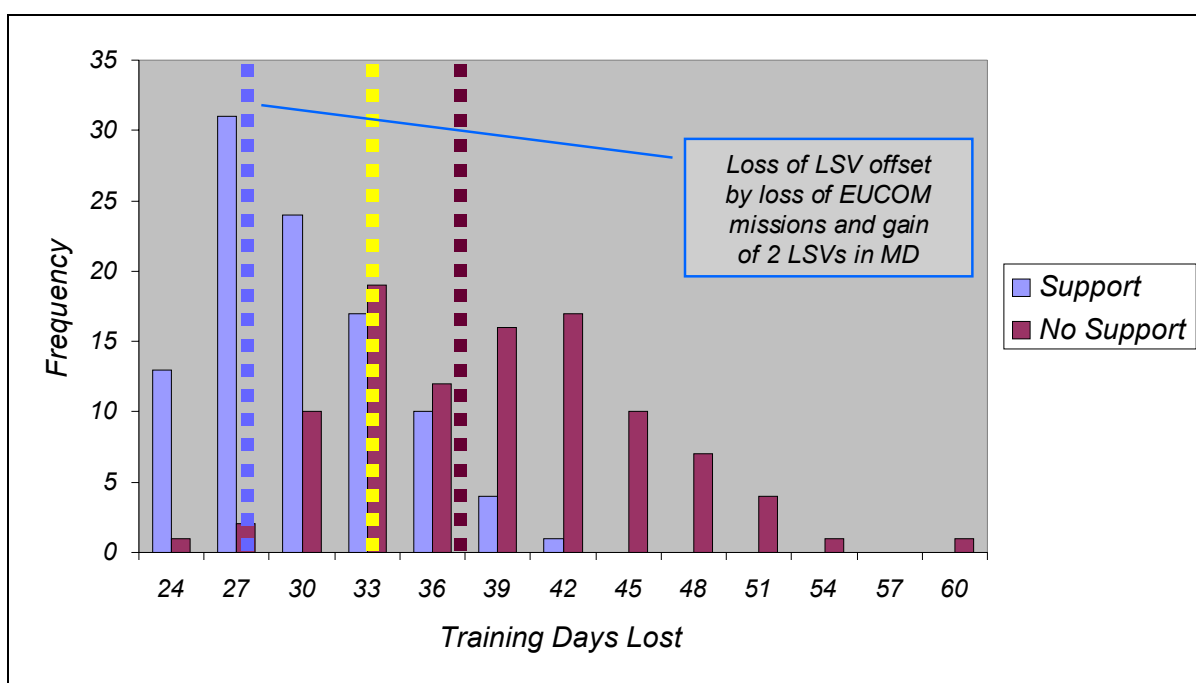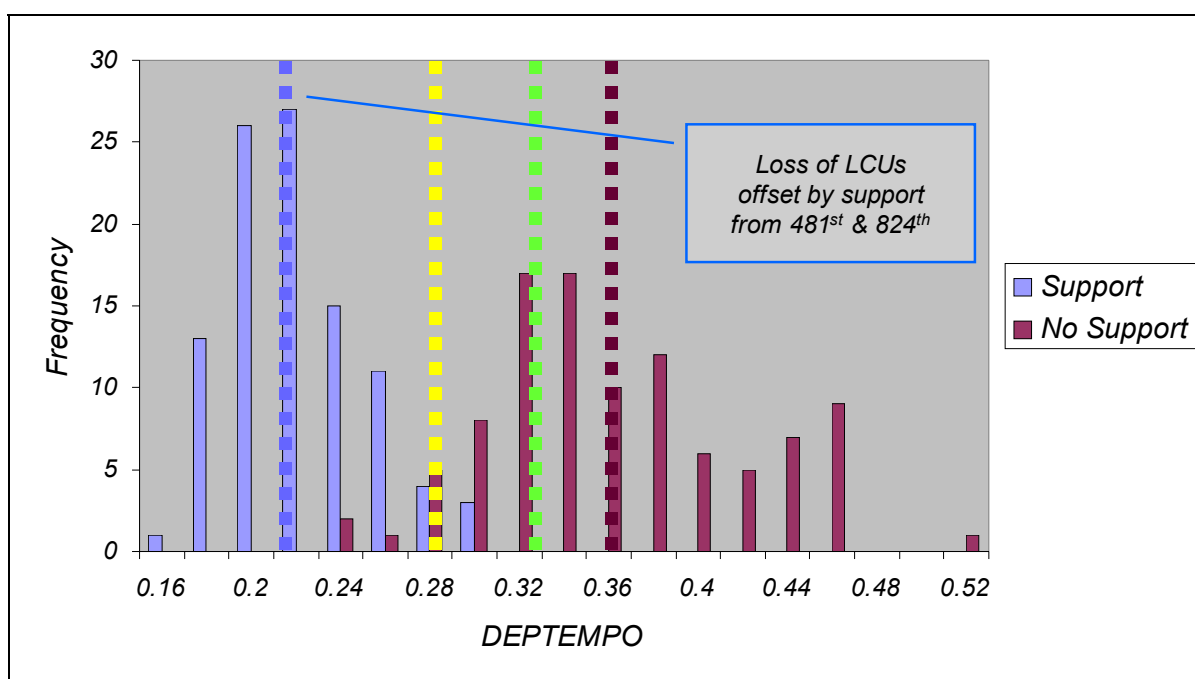

Figure 3. 7th Group's LSV DEPTEMPO

LSV Training Days Lost. 7th Group's simulated training days lost averaged 33 days per year from 1999-2001. Over 90 percent of these days were in support of the 8th Brigade. Under AWRP, average training days lost will either decrease to 28 days per year (with support) or increase to 37 days per year (without support). The gain of the two LSVs in Maryland, coupled with the transfer of EUCOM missions to LSV 6 offsets the loss of LSVs to CENTCOM and EUCOM. (*See Figure 4 below; the yellow dotted line indicates 1999-2001 average training days lost, the blue dotted line indicates forecasted average training days lost with support, the blue bars indicate the range in training days lost of the 100 runs with support, the purple dotted line indicates forecasted average training days lost without support, and the purple bars indicate the range in training days lost of the 100 runs without support*.)

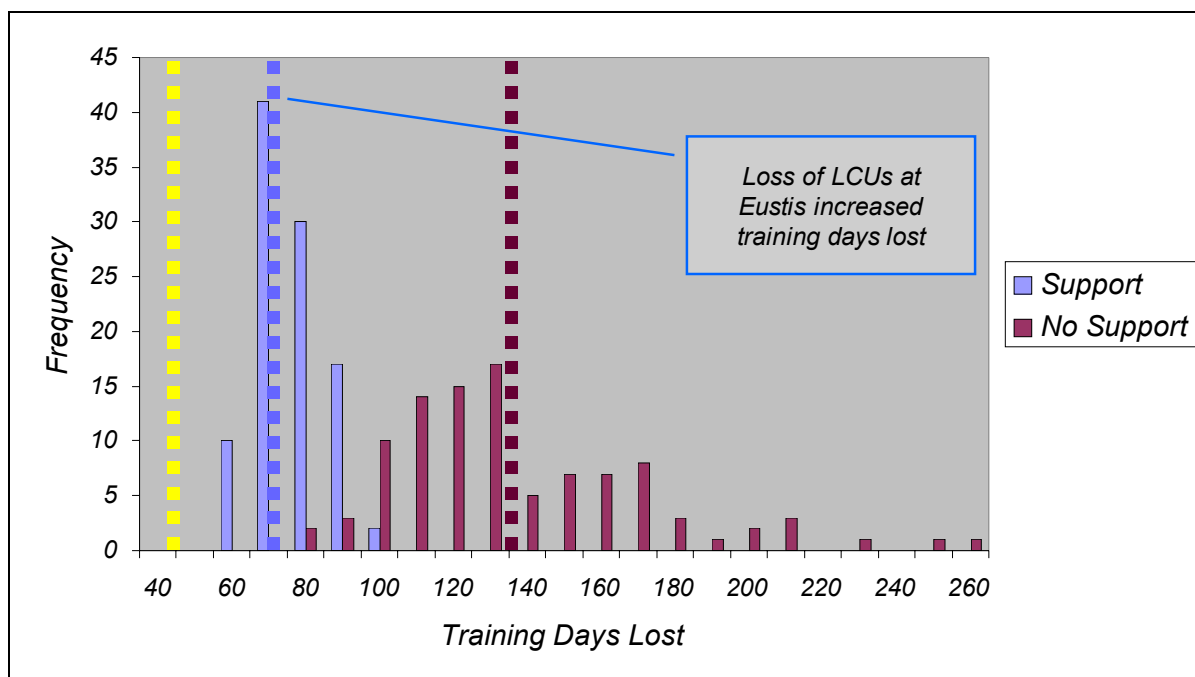**Figure 4. 7th Group's LSV Training Days Lost**

   LCU DEPTEMPO. 7th Group's simulated LCU DEPTEMPO averaged 28 percent from 1999-2001. Under AWRP, average DEPTEMPO will either decrease to 22 percent (with support from the other HBCs) or increase to 36 percent (without support). Support from the 481st and the 824th will more than offset 7th Group's loss of six LCUs and four AC crews, if unplanned demand is equitably spread across CONUS LCUs. (*See Figure 5 below; the yellow dotted line indicates 1999-2001 average DEPTEMPO, the blue dotted line indicates forecasted average DEPTEMPO with support, the blue bars indicate the range in DEPTEMPO of the 100 runs with support, the purple dotted line indicates forecasted average DEPTEMPO without support, the purple bars indicate the range in DEPTEMPO of the 100 runs without support, and the dotted green line represents the Army G3 DEPTEMPO maximum*).

**Figure 5. 7th Group's LCU DEPTEMPO**

LCU Training Days Lost. 7th Group's simulated training days lost averaged 45 days per year from 1999-2001. Over 90 percent of these days were in support of 8th Brigade. Under AWRP, average training days lost will increase to either 71 days per year (with support) or 133 days per year (without support). The loss of six LCUs and four AC crews at Fort Eustis significantly reduces the ability of 7th Group to support 8th Brigade. (*See Figure 6 below; the yellow dotted line indicates 1999-2001 average training days lost, the blue dotted line indicates forecasted average training days lost with support, the blue bars indicate the range in training days lost of the 100 runs with support, the purple dotted line indicates forecasted average training days lost without support, and the purple bars indicate the range in training days lost of the 100 runs without support.*)

**Figure 6. 7th Group's LCU Training Days Lost**

East Coast (-)

   LSV DEPTEMPO. No active LSV crews existed outside of 7th Group on the East Coast from 1999-2001. Under AWRP, LSV 9 will experience average DEPTEMPO of either 6 percent (with support) or 3 percent (without support). (*See Figure 7 below; the blue dotted line indicates forecasted average DEPTEMPO with support, the blue bars indicate the range in DEPTEMPO of the 100 runs with support, the purple dotted line indicates forecasted average DEPTEMPO without support, and the dotted green line represents the Army G3 DEPTEMPO maximum.*)
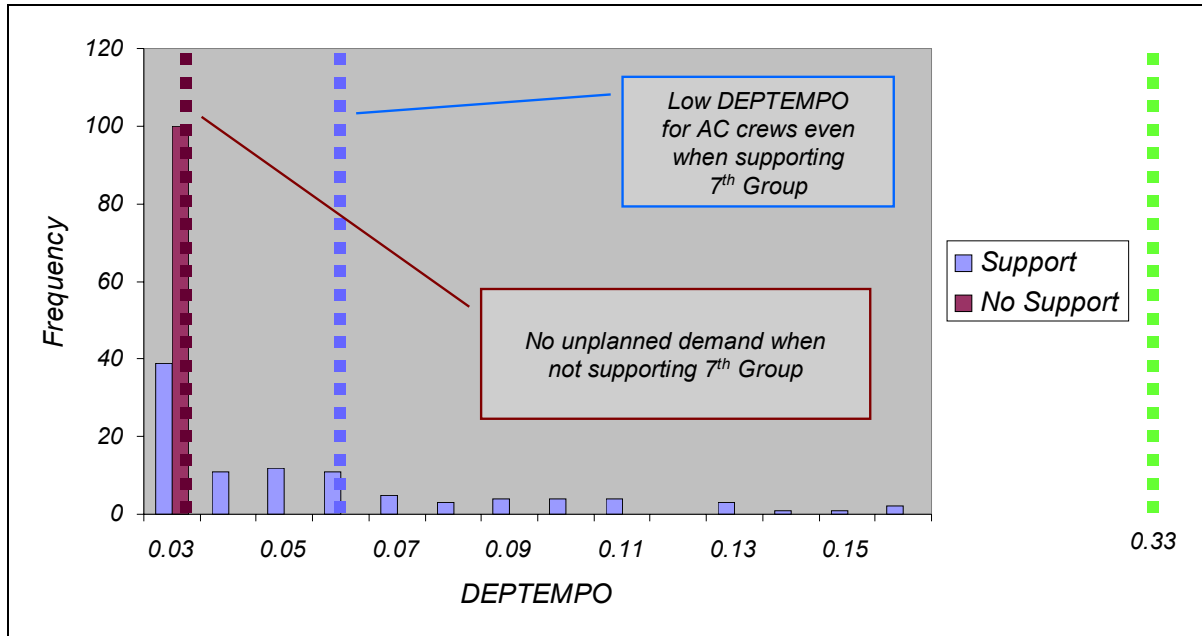

Figure 7. LSV 9's DEPTEMPO

LCU DEPTEMPO. The 824th HBC's simulated LCU DEPTEMPO averaged 9 percent from 1999-2001. Under AWRP, average DEPTEMPO will either increase to 16 percent (with support) or remain at 9 percent (without support). (*See Figure 8 below; the yellow dotted line indicates 1999-2001 average DEPTEMPO, the blue dotted line indicates forecasted average DEPTEMPO with support, the blue bars indicate the range in DEPTEMPO of the 100 runs with support, the purple dotted line indicates forecasted average DEPTEMPO without support, and the dotted green line represents the Army G3 DEPTEMPO maximum.*)
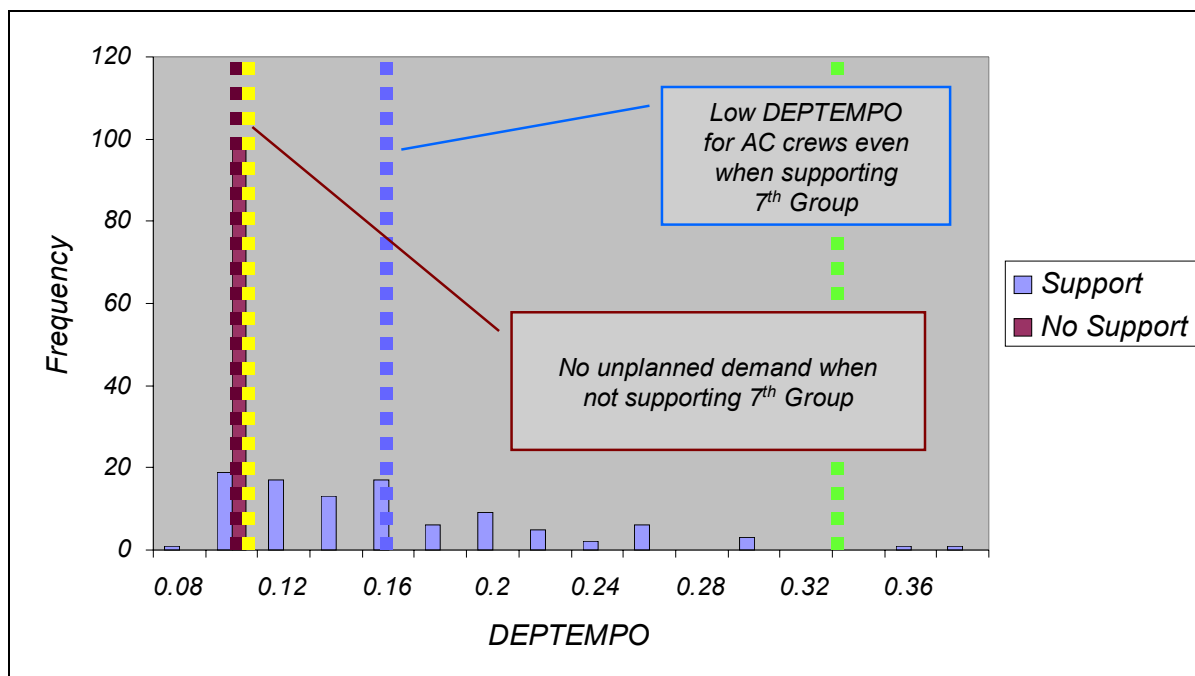
Figure 8. 824th LCU DEPTEMPO

West Coast.

   **LCU DEPTEMPO.** The 481st HBC's simulated LCU DEPTEMPO averaged 9 percent from 1999-2001. Under AWRP, average DEPTEMPO will either increase to 13 percent (with support) or remain at 9 percent (without support). (*See Figure 9 below; the yellow dotted line indicates 1999-2001 average DEPTEMPO, the blue dotted line indicates forecasted average DEPTEMPO with support, the blue bars indicate the range in DEPTEMPO of the 100 runs with support, the purple dotted line indicates forecasted average DEPTEMPO without support, and the dotted green line represents the Army G3 DEPTEMPO maximum.*)
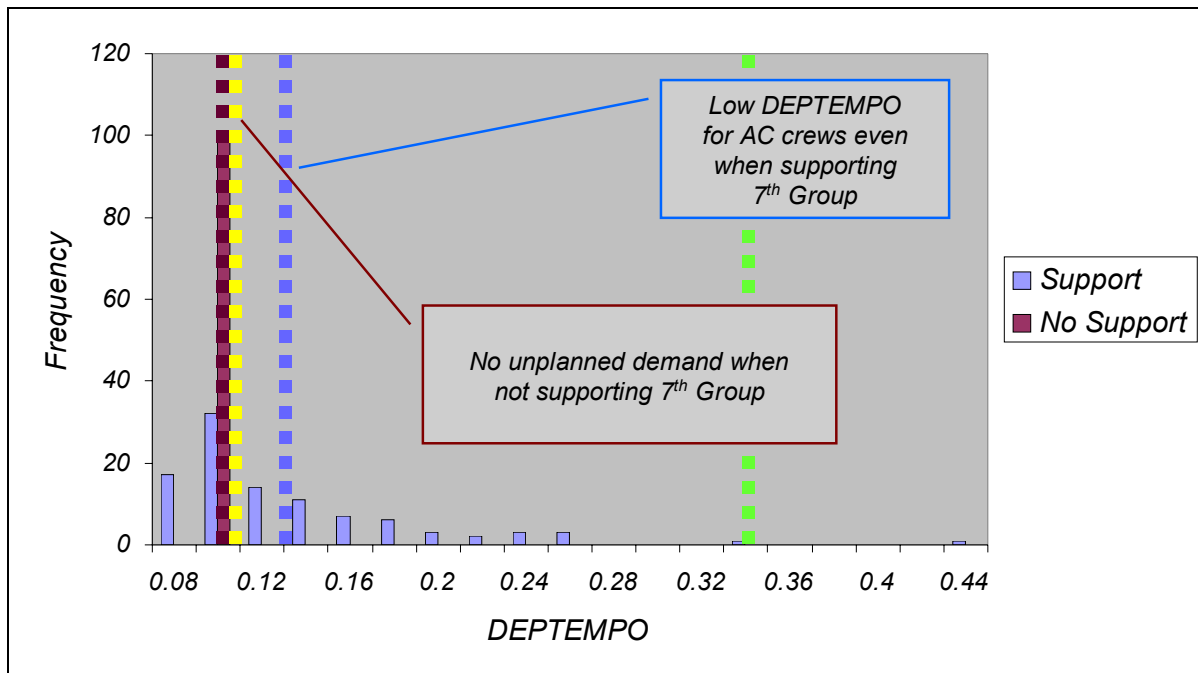
Figure 9. 481st LCU DEPTEMPO

PACOM.

LSV DEPTEMPO. PACOM's simulated LSV DEPTEMPO averaged 27 percent from 1999-2001. Under AWRP, average DEPTEMPO will decrease to 20 percent. (*See Figure 10 below; the yellow dotted line indicates 1999-2001 average DEPTEMPO, the blue dotted line indicates forecasted average DEPTEMPO, the blue bars indicate the range in DEPTEMPO of the 100 runs, and the dotted green line represents the Army G3 DEPTEMPO maximum.*)

DEPTEMPO decreased by addition of LSV 7
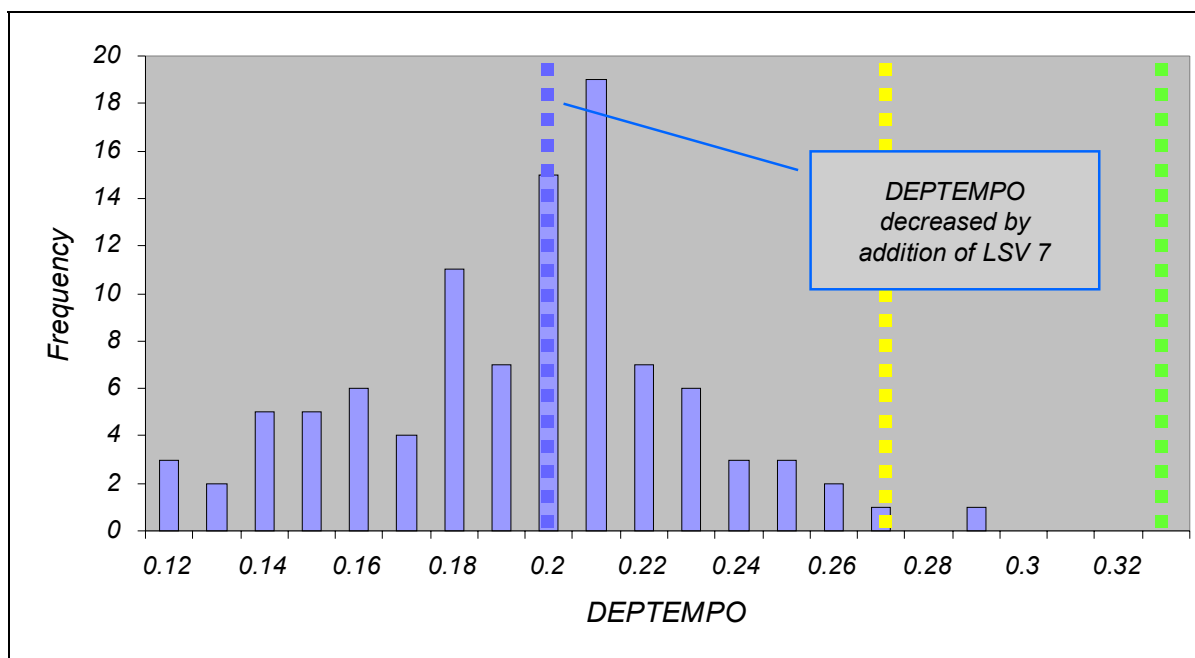
Figure 10. PACOM LSV DEPTEMPO

2.3   Summary

DEPTEMPO. All active LCU crews will experience average DEPTEMPO levels below 33 percent under AWRP. However, if unplanned demand is not equitably spread across the continental United States (CONUS) HBCs, the 97th HBC could experience DEPTEMPO levels as high as 36 percent. All active LSV crews will experience average DEPTEMPO levels below 33 percent under AWRP.

Training Days Lost. 8th Brigade will lose an average of 71 days per year of LCU support from 7th Group under AWRP. However, if unplanned demand is not equitably spread across CONUS HBCs, 8th Brigade will lose up to an average of 133 days per year of LCU support from 7th Group. 8th Brigade will lose an average of 28 days per year of LSV support from 7th Group under AWRP. However, if unplanned demand is not equitably spread across CONUS LSV detachments, 8th Brigade will lose up to an average of 37 days per year of LSV support from 7th Group.

Conclusions. AWRP appears to adhere to the first three directives given by the COT in 1999: (1) position Army watercraft for strategic and operational response, (2) ensure the quantity and type watercraft to support CINC requirements, and (3) balance the force structure without degrading capability. However, it fails to adhere to the fourth directive: (4) modernize and sustain the fleet while focusing on future investments. AWRP removes a significant proportion of the vessels at Fort Eustis that provide support to the 8th Brigade, endangering the ability of 8th Brigade to sustain the fleet with trained soldiers. The long-term implications of such cutbacks in support are beyond the scope of this study, but appear to threaten the ability of the Transportation Corps to field qualified crews.

Finally, the inferences drawn from this study should be limited to the near future only. As the watercraft fleet decreases its LCU fleet and increases its TSV fleet, support requirements from 8th Brigade and the manner in which unplanned demand is met (both by vessel type and number) will change. These changes violate, albeit slowly over time, the assumptions made in CA4WRP II. Fortunately, the simulation developed for CA4WRP II is flexible enough to simulate future scenarios, given planned and unplanned demand functions and supply parameters.

APPENDIX A PROJECT CONTRIBUTORS

1.   PROJECT TEAM

a. Project Director

MAJ Robert Shearer, Force Strategy Division

2.   PRODUCT REVIEWERS

Dr. Ralph E. Johnson, Quality Assurance
Ms. Nancy M. Lawrence, Publications Center

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APPENDIX B REQUEST FOR ANALYTICAL SUPPORT

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Performing Division: FS   *Account Number:*   **2002035**

Tasking: Informal   *Mode (Contract-Yes/No):*

Acronym: **CA4WRP**
Title: CAA's Analysis of the Army's Watercraft Restructuring Plan

Start Date: 15-Oct-01   *Estimated Completion Date:* 01-Nov-01

Requestor/Sponsor (i.e., DCSOPS): DCSLOG   *Sponsor Division:*   FPD

Resource Estimates: *a. Estimated PSM:* 0.5   *b. Estimated Funds:* $0.00

c. Models to be Used: **None**

Description/Abstract:
The Army has established a plan to restructure the watercraft fleet. CASCOM created this plan, taking into account the requirements for the fleet in wartime and day-to-day operations. This work omitted any analysis of the personnel impacts that the recommended changes would have on the fleet. CA4WRP analyzes PERSTEMPO and identifies other personnel issues that emerge from the restructuring plan.

Study Director/POC Signature: *Original Signed*   *Phone#:*   703-806-5685
Study Director/POC: **MAJ Robert Shearer**

If this Request is for an External Project expected to consume 6 PSM or more, Part 2 Information is Not Required. See Chap 3 of the Project Directors' Guide for preparation of a Formal Project Directive.

Background:

P

The COT directed a DTLOMS study of the watercraft fleet in 2000. CASCOM conducted the study, recommending changes in the fleet force structure. The study positioned the fleet for strategic and operational responsiveness, ensured

A

quality of support to the CINCs, balanced the force without loss of capability, and modernized and sustained the fleet.

R

DCSLOG expressed concern that personnel issues were not adequately addressed in the study.

T *Scope:*

Timeframe: 1999-2007. Scenario: 2 demand functions (USR and log book data) and 2 supply functions (1999-2001 authorized force structure and the proposed 2007 force structure). Forces: Floating Craft Companies (55500LC), LSV

2 Companies (55530L), and Heavy Boat Companies (55829L).

Issues:
1. What DEPTEMPO did the Army watercraft fleet experience from 1999-2001. 2. What DEPTEMPO will the Army watercraft fleet experience if the proposed reductions are implemented? 3. What factors, outside of unit deployments, are creating personnel problems within the watercraft fleet?

Milestones:
Initial ARB: 16 October. IPR to sponsor: 26 October. Final ARB: 31 October. Final brief to sponsor: 1 November.

Signatures *Division Chief Signature:*   *Original Signed and Dated*   *Date:*

Division Chief Concurrence: COL Mark Hanson

Sponsor Signature: *Original Signed and Dated*   *Date:*

Sponsor Concurrence (COL/DA Div Chief/GO/SES): DCSLOG-FPD

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